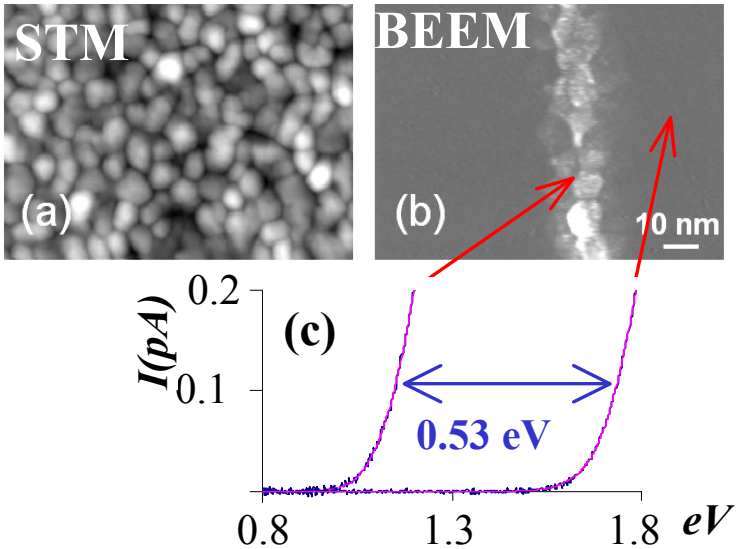
Nanometer-resolution study of self-forming Quantum Wells in Silicon Carbide,

Jonathan Pelz, Ohio State University Co-Pi on DMR-0076362

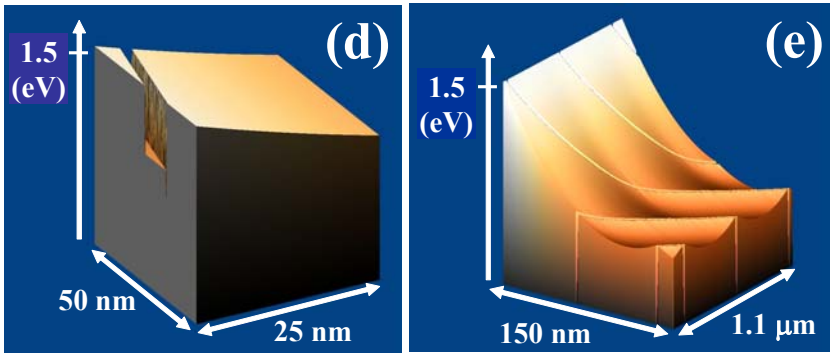
(in collaboration with B. Skromme, Arizona State U. - ECS-0080719)

Silicon Carbide (SiC) holds great promise for electronics at high-temperature, -frequency, and power, but can form complex crystal "polytype inclusions" that must first be understood and controlled. We have used Ballistic Electron Emission Microscopy (BEEM) to study *individual* SiC inclusions (Fig. **a)** under a polycrystalline Pt film (Fig. **b)**. We find they behave as unique "structure-only" Quantum Wells (QW's), which support a 2D electron band (left curve Fig. **c**, measured over an inclusion) at an energy ~0.53 eV below the surrounding host crystal (right curve, away from the inclusion). We have also used electrostatic modeling (Figs. **d** and **e**) to understand macroscopic Capacitance-Voltage curves, and to estimate a QW energy of ~0.59 eV deep in the bulk. *Partly funded by ONR.*

Manuscript in review at Phys. Rev. Lett.



BEEM spectra over (L) and away from (R) an inclusion.



Calculated potential profiles (d) near a metal interface, and (e) deep in the bulk where inclusions charge up.

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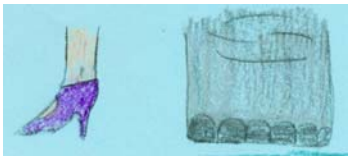
Education:

An undergraduate REU student (Adam Champion) and three graduate students (Kibog Park, Yi Ding, and Cristian Tivarus) contributed to this work. Yi Ding will graduate this Fall, and Adam Champion continues his undergraduate studies.

Outreach:

In addition to giving lab tours to high school students and other visitors, the PI presents yearly Physics demonstrations in elementary school classrooms (1st – 6th Grade). He has also worked with elementary school teachers to help prepare them (and their students) for the State Proficiency tests.

Artwork from 5th student Hannah: Spiked heal, elephant foot, bed of nails, liquid-nitrogen rocket help to understand *pressure*. "… It's marvelous how science and technology work together to revolutionize the way we live."



From her teacher: "The kids absolutely lit up when I asked about your visit. The rocket, the bed of nails and the floating magnet- all sounded terrific. Best of all they were able to give me some pretty solid specifics as to the science behind each one."

From visit to a 2nd grade classroom. The air in the balloon will soon "shrink" in liquid nitrogen.